

THE
Gregorian and Julian
 CALENDARS,
 OR, THE
 New and Old STILES,
 ARITHMETICALLY explained.

Wherein is Taught

How to find the Leap-Years, Golden Numbers, Epacts, Dominical Letters, *Easter* Day, the Moon's Age, the Moon's Southing, and the Times of High Water, in both Accounts, for Ever.

WITH

Every Thing necessary for the understanding the proposed Method for correcting the CALENDAR now in Use; the *Gregorian* Stile being reduced to the proposed Method for correcting the CALENDAR.

By AARON HAWKINS.

The Law is good, 1 Tim. chap. i. ver. 8.

L O N D O N :

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NEW AND OLD STILLS



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P R E F A C E.

SINCE the Reformation of the Calendar by Pope Gregory the XIIIth, Anno 1582. several Proposals have been made in his Majesty's Dominions, in order to reduce our Stile to the Gregorian, but to no Purpose; for the Proposers, most of them unable to bring their Proposals into Parliament, and others void of Truth, that none dare attempt it; but now it is thought will pass into a Law, according to the Bill which is in the Honourable House of Commons (it having already passed the House of Lords) and how can it be otherwise, when such Great and Learned Men have taken it in Hand, as the noble Earls of Chesterfield and Macclesfield, Martin Folks, Esq; President of the Royal Society, Dr. Bradley, his Majesty's Professor of Astronomy, and Mr. Duvall, Barrister in the Temple, all of them Stars of the first Magnitude in the Horizon of Truth.

But I shall not trouble my Reader with a long Preface, the Body of the Book not permitting it, only assure him, that the Rules in this small Treatise are reduced to the proposed Method for correcting the Calendar now in Use.

AARON HAWKINS.



PREFACE

CONTENTS.

O <i>F the Julian Leap-Years,</i> Chap. 1.	p. 1.
<i>Of the Gregorian Leap-Years,</i> Chap. 2.	p. 2.
<i>Of the Julian and Gregorian Golden Numbers,</i> Chap. 3.	p. 4.
<i>Of the Epacts according to the Julian Calendar,</i> Chap. 4.	p. 6.
<i>Of the Gregorian Epacts,</i> Chap. 5.	p. 8.
<i>Of the Julian Dominical Letter,</i> Chap. 6.	p. 15.
<i>Of the Gregorian Dominical Letter,</i> Chap. 7.	p. 18.
<i>Of Easter Day, according to the Julian Ca-</i> <i>lendar,</i> Chap. 8.	p. 22.
<i>Of the Gregorian Easter Day,</i> Chap. 9.	p. 26.
<i>Of the Moon's Age,</i> Chap. 10.	p. 32.
<i>Of the Moon's Southing,</i> Chap. 11.	p. 36.
<i>Of the Time of High Water,</i> Chap. 12.	p. 40.
<i>Of the Calends, Nones and Ides,</i> Chap. 13.	p. 45.
<i>Of the Roman Indiction,</i> Chap. 14.	p. 46.
<i>Of the Julian Period,</i> Chap. 15.	p. 47.

ARON LAWRENCE



THE
Gregorian and Julian
CALENDARS,
 Arithmetically Explained.

CHAP. I.

Of the *Julian* Leap-Years.



HO^d the Solar Year, or the Earth's Revolution in the Ecliptic, is about 365 Days 5 Hours 49 Minutes; yet we reckon only 365 Days (excepting in Leap-Year) omitting the 5 Hours 49 Minutes, which are but 11 Minutes short of 6 Hours, that it comes, that every common Year is about 6 Hours too short, which in four Years make almost a Day, and that Day we add or put in, in the Month of *February* in every 4th Year, which is stiled the Bissextile Year, by reason it contains 366 Days; now to know if the Year proposed is Bissextile or not.

B

The

The RULE.

Divide the Number of Years by 4, and if there is no Remainder, it's a Leap-Year, or a Year of 366 Days; but if 1, 2, or 3 remain, it is 1, 2, or 3 Years after Leap-Year, and those Years contain only 365 Days.

EXAMPLE I.

If the given Year is 1748, which divided by 4 gives 437 for the Quotient, and no remainder, which according to the Rule was a Leap-Year, or a Year of 366 Days.

EXAMPLE II.

Suppose the given Year to be 1751, which divided by 4, gives 437 for the Quotient, and 3 remaining, which according to the Rule is 3 Years after Leap-Year, and contains only 365 Days.

C H A P. II.

Of the Gregorian Leap-Years.

THE *Gregorian* Leap-Years is found after the same Manner as the *Julian*, only in the Hundredth Years, which was the Reason of the Reformation of the Calendar, *Anno* 1582, by Pope *Gregory XIII.* and is likely to produce the same Effect in his Majesty's Dominions.

If the Tropical Year was precisely 365 Days, 6 Hours, the *Julian* Stile had needed no Correction; but its Length according to Dr. *Halley*, is found to be 365 Days, 5 Hours, 48' 54" 41''' 27'''' 31'''' which is short of 365 Days, 6 Hours, by 11' 05" 18" 32''' 29'''' and this in 400 Years amount-
ing

ing to 3 Days 1 Hour 55' 23" 36''' 33''' 20''' so that since the General Council of *Nice*, *anno* 325, the Seasons of the Year have gone back 11 Days, and this Error is still increasing; so that if the *Julian* Year goes on thus without any Correction, the Vernal or Spring Equinox, in about 9 or 10 Thousand Years will be upon *Christmas* Day; how strangely will the Seasons of the Year be alter'd, to what they are now, if any People were to be alive to see it! But if the World endure so long, the People then living will not know any Alteration, because this Alteration is made gradually, and by little and little; so that in an Age the Vulgar cannot perceive it.

To prevent the like Retrogradation for the future, Pope *Gregory XIII.* *anno* 1581, issued his Bull; ordering 1. That, in 1582, the 5th of *October* should be called the 15th and so on. 2. The Astronomical Tables and Observations of that Time making the Anticipation of the Equinox to be at the Rate of 3 Days in 400 Years, he ordered, that every 400 Years, 3 Days should be suppressed, by reckoning the grand Jubilees, or centenar Years 1700, 1800, 1900, which, in the *Julian* Calendar are Leap-Years, to be common Years of 365 Days. This Rule not taking place till 1700, because the 10 Days already suppressed, exceeding the just Quantity, including the Correction due from 1582 to 1700. And to know if the Hundredth Years are Leap-Years, or Common, take this

R U L E.

Reject two Cyphers to the right Hand, and divide the remaining Figures or Cyphers by 4, and if nothing remain it is a Bissextile, but if any thing remain it is a common Year.

EXAMPLE I.

To know if the Year 1800 is 'a Biffextile or common Year, divide 18 by 4, and the Remainder is 2, which, according to the Rule, is a common Year.

EXAMPLE II.

To know if the Year 2000 is a Biffextile or Common Year, divide 20 by 4, and there remains nothing, which, according to the Rule, is a Biffextile Year, or a Year of 366 Years.

C H A P. III.

Of the Julian and Gregorian Golden Numbers.

THE Golden Number, or Cycle of the Moon, is also called the Metonic Cycle, called so from its Inventor *Meton*, and is a Period of 19 Years, which when they are completed, the New Moons and Full Moons return on the same Days of the Month; so that on whatever Days the New and Full Moons fall this Year, 19 Years hence they will happen on the very same Days of the Month (though not at the same Hour) as *Meton*, and the Fathers of the Primitive Church thought; and therefore at the Time of the Council of *Nice*, when the Way of setting the Time for observing the Feast of *Easter* was established, the Numbers of the Lunar Cycle were inserted in the Calendar, which, upon the Account of their excellent Use, were set in Golden Letters, and the

[5]

the Year of that Cycle for any Year, was called the Golden Number of that Year, which how to find take the following

R U L E.

Add one to the Year of our Lord, and divide by 19, the Remainder is the Golden Number, but if nothing remain the Golden Number is 19.

E X A M P L E I.

What will be the Golden Number for the Year 1753 ?

$$19)1754(92$$

$$\underline{} \\ \cdot 44$$

$$\underline{} \\ \cdot 6$$

I add one to the Year 1753, which makes 1754, and divide by 19, the Remainder 6 is the Golden Number.

E X A M P L E II.

What will be the Golden Number for the Year 1792 ?

$$1792$$

$$\underline{} \\ \cdot 1$$

$$19)1793(94$$

$$\underline{} \\ \cdot 83$$

• 7 The Golden Number for that Year.

E X A M P L E

EXAMPLE III.

What will be the Golden Number for the Year 1766?

$$\begin{array}{r}
 1766 \\
 \text{I} \\
 \hline
 19 \overline{)1767(93} \\
 \hline
 \cdot 57 \\
 \hline
 \cdot \cdot
 \end{array}$$

In this last Example nothing remaining, the Golden Number, according to the Rule, will be 19.

Note, That the Golden Number is the same in the *Julian*, as in the *Gregorian Calendar*.

C H A P. IV.

Of the EPACTS, according to the Julian Calendar.

THE Solar Year containing 365 Days 5 Hours 48' 54" 41''' 27'''' 31''''' , and between one Conjunction of the Sun and Moon, and another is 29 Days 12 Hours 44' 06'' , which multiplied by 12, gives 354 Days 08 Hours 49' 12'' for the length of the Lunar Year ; which taken from the Solar Year, leaves 10 Days 20 Hours 59' 42" 41''' 27'''' 31''''' . But to avoid Fractions in Practice, the Epact is called

[7]

11, which you see is too much by 3 Hours 00'
17'' 18''' 32'''' 29'''''.

The R U L E.

Multiply the Golden Number by 11, and divide the Product by 30, the Remainder is the Epact for the Year proposed.

EXAMPLE I.

What was the Epact for the Year 1748?

$$\begin{array}{r} 1748 \\ \times 11 \\ \hline 19)1749(92 \\ \hline \end{array}$$

39

I The Golden Number
II Multiplied by

The Epact 11

In this Example, because 11 cannot be divided by 30, therefore the Epact is 11.

EXAMPLE

EXAMPLE II.

What was the Epact for the Year 1738 ?

1738

I

19)1739(91

29

The Golden Number 10
Multiplied by 11

30)110(3

The Epact 20

CHAP. V.

Of the Gregorian EPACT.

THE Synodical Month, or the Space of Time contained between the Moon's parting from the Sun, at a Conjunction, and returning to him again, is 29 Days 12 Hours 44 Minutes and 6 Seconds, consequently 235 Lunations are made in 6939 Days 16 Hours 43 Minutes 30 Seconds; and 19 *Julian* Years are 6938 Days 18 Hours, and consequently, the New Moons, after 19 *Julian* Years, will not return to the same Hour of the Day, but will happen 1 Hour 16 Min. 30 Sec. sooner; which in the Space of 357 and $\frac{3}{4}$ Years, nearly; but, according

according to some Authors, it will be but 310 Years, amounting to 1 entire Day, because they make the Length of the Lunar Synodical Month consist of 29 Days 12 Hours 44 Min. 3 Sec. Therefore 235 Lunations are made in 6939 Days 16 Hours 31 Min. 45 Sec. which are less than 19 *Julian* Years by 1 Hour 28 Min. 15 Sec. nearly agreeing with what the noble Earl of *Macclesfield* deliver'd in his Speech before the House of Peers, that noble Earl making the Anticipation in 19 Years to be 1 Hour 28 Min. 3 Sec. 30 Thirds, which in 310.7 Years, amounts to one entire Day.

And now because the New Moons do not return at the same Time of the Day, but 1 Hour 28' 03" 30''' sooner than they did 19 Years before; and that in 310.7 Years they will anticipate one Day, which proves that the Epact itself varies one Day in 310.7 Years, so that since the General Council of *Nice*, which was in the Year 325, the New Moons have anticipated between 4 and 5 Days, and consequently the Epacts should have decreased in the same Proportion, as the New Moons anticipated, in order to find the Time of the New and Full Moons by the Epacts; but before we can find the Epacts according to the *Gregorian* Calendar, we must find how many Days the *Gregorian* Stile has gained of the *Julian*, which how to find use this

R U L E I.

Reject two Figures or Cyphers, to the Right Hand, and divide the remaining Figures or Cyphers, consisting of entire Hundred Years by 4, reject the Remainder, and add 2 to the Quotient, this Sum subtracted from the entire

C

Hun-

Hundred Years, leaves the Number of Days that the *Gregorian* Stile has gained of the *Julian*.

EXAMPLE I.

In the Year 3500, I would know how many Days the *Gregorian* Stile will have gained of the *Julian*.

$$\begin{array}{r}
 4 \overline{) 35} \text{ The entire Hundred Years} \\
 \underline{} \\
 \text{The Quotient } 8 \\
 \underline{} \\
 \text{Add } 2 \\
 \underline{} \\
 \text{Sub. } 10 \\
 \underline{} \\
 25
 \end{array}$$

Answ. The *Gregorian* will have gained of the *Julian* in that Year 25 Days.

EXAMPLE II.

In the Year 11752, I would know many Days the *Gregorian* will have gained of the *Julian* Stile ?

$$\begin{array}{r}
 4 \overline{) 117} \text{ the entire Hundred Years} \\
 \underline{} \\
 \text{The Quotient } 29 \\
 \text{Add } 2 \\
 \underline{} \\
 \text{Subtract } 31 \\
 \underline{} \\
 86 \text{ Days}
 \end{array}$$

Answ. The *Gregorian* will have gained of the *Julian* 86 Days; by which is plainly seen the Error of the *Julian* Stile.

To

To find the Gregorian Epact.

The R U L E. II.

1st. Find the *Julian* Epact, and then subtract the Number of Days that the *Gregorian* Stile has gained of the *Julian*, from the *Julian* Epact, and the Remainder will be the *Gregorian* Epact, but if Subtraction cannot be made, you must add 30, as often as needful.

E X A M P L E I.

I would find the *Gregorian* Epact for the Year 1753.

According to the last Chap. I find the *Julian* Epact to be 6, and by the first Rule in this Chap. I find that the *Gregorian* Stile is 11 Days before the *Julian*, then

The <i>Julian</i> Epact	6
Add	30
	—
Sum	36
Subtract	11
	—
The <i>Gregorian</i> Epact	25

E X A M P L E II.

To find the *Gregorian* Epact for the Year 1786.

The *Julian* Epact for that Year will be 11, from which subtract 11, the Number of Days that the *Gregorian* Stile has gained of the *Julian*, proves that that Year will have no Epact.

It was observ'd before in this Chap. that the Epacts should be decreased in Proportion to the

Anticipation of the Moon, therefore the Rule already deliver'd will not hold good any longer than the Year 1799, but by the help of the following Table, the Epacts may be calculated for ever, and consequently the Moon's Age found from them will agree very near with the Truth.

No.	Years of our Lord.	No. to be sub.	No.	Years of our Lord.	No. to be sub.	No.	Years of our Lord.	No. to be sub.
1	1600	10	25	4000	20	49	6400	0
2	1700	11	26	4100	21	50	6500	1
3	1800	11	27	4200	22	51	6600	2
4	1900	12	28	4300	22	52	6700	3
5	2000	12	29	4400	22	53	6800	2
6	2100	12	30	4500	23	54	6900	3
7	2200	13	31	4600	23	55	7000	4
8	2300	14	32	4700	24	56	7100	4
9	2400	13	33	4800	24	57	7200	4
10	2500	14	34	4900	24	58	7300	5
11	2600	15	35	5000	25	59	7400	5
12	2700	15	36	5100	26	60	7500	6
13	2800	15	37	5200	25	61	7600	6
14	2900	16	38	5300	26	62	7700	6
15	3000	16	39	5400	27	63	7800	7
16	3100	17	40	5500	27	64	7900	8
17	3200	17	41	5600	27	65	8000	7
18	3300	17	42	5700	28	66	8100	8
19	3400	18	43	5800	28	67	8200	9
20	3500	19	44	5900	29	68	8300	9
21	3600	18	45	6000	29	69	8400	9
22	3700	19	46	6100	29	1	8500	10
23	3800	20	47	6200	0	2	8600	11
24	3900	20	48	6300	1	3	8700	11

This Table is composed of a Period 6900 Years which is numbred in the 1st Column of the Table from 1 to 69, the second Column contains the entire hundred Years, from 1600 to the Year 8700, and the third Column contains the Number that must be substracted from the *Julian* Epact, in order to find the *Gregorian*; this Table will be of great Use in order to find the mean Lunations for ever, and may be made perpetual by the following

R U L E III.

Add to the entire Hundred Years the Number 54 and if the Sum exceeds 69, divide it by 69, and the Remainder will be the Number of the Period, but if the Sum is equal to, or less than 69, the Number of the Period is given by adding 54 to the Hundred Years.

E X A M P L E I.

I would know the Epact for the Year 325, the Year that the General Council of *Nice* was holden.

I find the Golden Number for that Year to be 3, the Epact 3 according to the *Julian* Calendar.

The Hundred Years	3
Add	54
	—
The Number of the Period	57

With which I enter the 1st Column of the Table, and against it in the 3d Column stands 4, the Number to be substracted from the *Julian* Epact.

The

[14]

The <i>Julian</i> Epact	3
Add	30
Sum	33
Subtract the Number of the Period	} 4
The Epact	29

EXAMPLE II.

What will be the Epact for the Year of our Lord 2104.

	19)2104(110
	20
The Golden Number	14
	11
	3 0)15 4(5
The <i>Julian</i> Epact	4
Add	30
The Sum	34
The Number of the Period subtract	} 12
The Epact	22

By this Method of finding the Epacts, *Easter* Day, and all Things thereon depending, may for ever be found, according to the Method proposed for correcting the Calendar.

CHAP,

C H A P. VI.

Of the Julian Dominical Letter.

TH E Year is divided into 52 Weeks, of 7 Days each, and one Day over, by means of the first seven Letters of the Alphabet A, B, C, D, E, F, G, perpetually recurring throughout the Year. A stands against the 1st of *January*, B against the 2, and so on to *December* the 31st, which has A joined to it. The Letter which stands against all the Sundays of the Year, is called the Dominical or Sunday Letter for that Year. If *January* the 1st be *Sunday*, A is the Dominical Letter, which stands against every *Sunday* throughout the Year, except it be Leap-Year, for then the Dominical Letter changes at the End of *February*, moving a Letter backwards, so that G will be the *Sunday* Letter during the Remainder of the Year; for the Dominical Letter always shifts backwards, as from A to G, from G to F, and from F to E. If E be the Dominical Letter this Year, D will be the Dominical Letter for the next; to find the Dominical Letter for any Year, use this

R U L E.

Divide the Year, its 4th Part and 4 by 7, the Remainder subtract from 7, gives you the Number of the Letter, as here is set down.

A, B, C, D, E, F, G.

1, 2, 3, 4, 5, 6, 7.

Note,

Note, If after you divide by 7, nothing remain, the Dominical Letter is then G.

EXAMPLE I.

What is the Dominical Letter for the Year 1751?

$$\begin{array}{r}
 4)1751 \\
 \underline{437} \\
 4 \\
 \hline
 7)2192(7 \\
 \underline{} \\
 313-1 \\
 \underline{} \\
 6
 \end{array}$$

The Number of the Dominical Letter.

The Number 6, according to the Rule, answers to F, so that F is the Dominical Letter for the Year.

EXAMPLE II.

What was the Dominical Letter for the Year 1748?

$$\begin{array}{r}
 4)1748 \\
 \underline{437} \\
 4 \\
 \hline
 7)2189(7 \\
 \underline{} \\
 312-5 \\
 \underline{} \\
 2
 \end{array}$$

The Number of the Dominical Letter.

Which, according to the Rule, answers to B.

By

By the Dominical Letter, you may compute on what Day of the Week any Day of the Month will fall throughout the Year, by this

R U L E.

1	2	3	4	5	6
At	Dover	Dwells	George	Brown	Esquire,
7	8	9	10	11	12
Good	Christopher	Finch,	And	David	Frier,

Where the twelve Words answers to the twelve Months. The first Letter of each Word stands in the Calendar against the first Day of the corresponding Month, as A against *January* the 1st, D against *February* the 1st, &c.

E X A M P L E I.

In the Year 1748, B was the Dominical Letter, I would know on what Day of the Week *June* the 24th was that Year.

E stands against *June* the 1st, *per* Rule; remember that the 1st, 8th, 15th, 22d, 29th, is the same Day of the Week in each Month. Now if B be *Sunday*, E is *Wednesday*; therefore *June* the 22d is *Wednesday*, consequently the 24th was of a *Friday*.

E X A M P L E II.

Suppose *Christmas* Day this Year 1751, I would know what Day of the Week it will fall on.

F is the Dominical Letter for this Year, and F stands against *December* the 1st, the 22d must be of a *Sunday*, and the 25th of *Wednesday*, *Christmas* Day.

C H A P. VII.

Of the Gregorian Dominical Letter.

TH E Years following according to the *Gregorian* Calendar, are Years of 365 Days, *viz.* 1800, 1900, 2100, 2200, 2300, &c. and for those Years there is but one Dominical Letter, which Years, according to the *Julian* Calendar, would have two, which must change the Course of the Dominical Letters quite different from the *Julian*. To find the *Gregorian* Dominical Letter, use the following

R U L E.

Divide the Year and its 4th Part by 7, the Remainder subtracted from 7 gives the Dominical Letter as in the *Julian* Calendar.

A, B, C, D, E, F, G.

1, 2, 3, 4, 5, 6, 7.

E X A M P L E I.

I would know the Dominical Letter for the Year 1754?

$$\begin{array}{r} 4)1754 \\ \underline{438.2} \end{array}$$

$$\begin{array}{r} 7)2192(7 \\ \underline{} \end{array}$$

$$\begin{array}{r} 3131 \\ \underline{} \end{array}$$

6

The Number of the Dominical Letter.

The

The Number 6, according to the Rule, gives the Dominical Letter F.

EXAMPLE II.

What will be the Dominical for the Year 1764 ?

$$\begin{array}{r} 4)1764 \\ \underline{441} \\ 7)2205 \ 7 \\ \underline{315 \ 0} \end{array}$$

The No. of the Letter 7 Answers to G.

This Method of finding the Dominical Letter, will only hold good for this Century ; the Dominical Letter then changing its Course, and then a Number must be added to the Year, and its 4th, in order to find the Dominical Letters for ever, for which Purpose take this

R U L E.

Reject the Figures or Cyphers, to the Place of Hundreds. Divide the remaining Figures or Cyphers, by 4 ; from this Quotient subtract 1, and this Number subtracted from the Hundred Years, and then this last Remainder taken from the least Number of Sevens possible, leaves a Number which must be added to the Year and its 4th, in order to find the Dominical Letter according to the *Gregorian* Calendar.

[20]

EXAMPLE I.

What will be the Dominical Letter for the Year 1842 ?

4)18(4 The Quotient
3 1 Subtract

15 3
21
—

The No. to be added 6

4)1842
460
6
—

7)2308.7
329.5
—

The No. of the Letter 2 Answers to B.

What will be the Dominical Letter for the Year 1947 ?

4)19(4
3 1
—

16 3
21
—

The No. to be added 5

4)1947
486
5
—

7)2438 7
—
348 2
—

The No. of the Letter 5 Answers to F

Or the *Gregorian* Dominical Letter may be found by subtracting the Number of Days that the *Gregorian* Stile has gained of the *Julian*, before you divide by 7, in proceeding to find the *Julian* Dominical Letter.

The Number of Days that the *Gregorian* Stile has gained of the *Julian*, may be found by the 1st Rule of the 5th Chapter, the two last Examples work'd by this Rule.

$$\begin{array}{r} 4)18(4 \\ 62 \end{array}$$

$$126$$

$$\begin{array}{r} 4)1842 \\ 460 \\ 4 \end{array}$$

$$2306$$

$$12$$

$$\begin{array}{r} 7)22947 \\ 3275 \end{array}$$

$$2$$

The Number of the Dominical Letter, as before, answers to B.

EXAMPLE II.

$$\begin{array}{r}
 4)19(4 \\
 \underline{6} \quad 2 \\
 13 \quad 6 \\
 \underline{} \\
 4)1947 \\
 \underline{486} \\
 4 \\
 \underline{} \\
 2437 \\
 \text{Sub.} \quad 13 \\
 \underline{} \\
 7)2424 \quad 7 \\
 \underline{346} \quad 2
 \end{array}$$

Number of the Letter 5 answers to E.

C H A P. VIII.

Of Easter Day, according to the Julian Calendar.

BY a too strict Adherence to the *Julian* Year, and that too much applauded erroneous Lunar Cycle, invented by *Meton* the *Athenian*, 400 Years before our Saviour's Incarnation, and unluckily introduced into the Christian Calendar 8 or 9 Hundred Years after, *Easter* fails in these Times, at least thrice in 21 Years of being observed, as the Rule in the Common-Prayer-Book hath established it, for the Rule says, "*Easter Day* (on which the rest
" depends)

“ depends) is always the first *Sunday* after the
 “ first Full Moon which happens next after the
 “ 21st Day of *March*, and if the Full Moon
 “ happens on a *Sunday*, *Easter* Day is the *Sunday*
 “ after.” This Grand Festival is often celebrated
 on the 22d of *March*, quite contradictory to the
 foregoing Rule.

But this Error is still increased according to the
 Rule first established by the General Council of
Nice, which runs thus : First, That *Easter* should
 every where be begun to be observed on the first
 Day of the Week, that is *Sunday*. Secondly,
 That it should be on the *Sunday* that should follow
 next after the 14th of the Moon that should
 happen next after the Vernal Equinox. And,
 Thirdly, That it should be referred to the Bishop
 of *Alexandria*, to calculate every Year on what
 Day, according to these Rules, the said Festival
 should begin. When it's very well known in
 these Times that the 14th of the Moon, or the
 Full Moon, as they called it, happens very often
 between the 9th or 10th of *March*, and the 21st
 Day of the said Month, which contradicts the
 aforesaid Canons, every time it so happens. But
 it's to be hoped these Difficulties will be removed
 soon ; but till they are make use of this

R U L E.

Find the Epact for the Year proposed, and if
 it is less than 28 or 29, subtract it from 47 ; but
 if be 28 or 29, subtract it from 77, the Re-
 mainder is the Day of the Month in *March* or
April, or *Easter* Limit for that Year ; which if
 it be less than 31, look in the Month of *March*,
 and count on from that Day or Limit, till you
 come to the *Sunday* Letter for that Year, for
 that is *Easter* Day. But if the Limit exceeds

31, subtract 31 from it, and count in *April* for the Day or Limit, until your reckoning end at the Dominical Letter for that Year; and that gives you *Easter* Day in *April*. Or having the Dominical Letter for any given Year, number it as is directed Chapter VI. and add 4 to it always. This Sum take from the Limit; what remains, you must subtract from the nearest Sum of Sevens; and this Remainder you must add to *Easter* Limit, gives *Easter* Day in *March*, if less than 32, or in *April* if more.

EXAMPLE I.

If the given Year is 1752, on what Day will *Easter* fall?

The Dominical Letter, according to Chapter VI. will be D, and the Epact 25, according to Chap. IV.

	From 47
	Sub. Epact. 25
	—
	<i>Easter</i> Limit 22
Sum of the Letter + 4.	8
	—
	14
Nearest Sum of 7 s.—	21
	—
	7 Add to Limit 22
	7
	—
	<i>Easter</i> Day, <i>March</i> 29

EXAMPLE

EXAMPLE II.

What Day of the Month was *Easter* Day,
1740?

The Epact 12.

The Dominical Letter E.

$$\begin{array}{r}
 \text{From } 47 \\
 \text{Sub. Epact } 12 \\
 \hline
 \text{Easter Limit } 35 \\
 \text{Sum of the Letter } + 4 = 9 \\
 \hline
 26 \\
 \text{Nearest Sum of } 7\text{s. } 28 \\
 \hline
 2 \text{ Add to Limit } 35 \\
 2 \\
 \hline
 37 \\
 \text{March } 31 \\
 \text{Easter Day, April 6.}
 \end{array}$$

All the rest of the moveable Feasts being dependant on *Easter*, may very soon be found, for *Shrove-Sunday* is seven Weeks before *Easter*, and *Whit-Sunday* seven Weeks after, *Ascension* Day forty Days after, and *Trinity Sunday* eight Weeks after *Easter* Day, &c.

C H A P. IX.

Of Easter Day, according to the Gregorian Calendar.

IT was observed in the last Chapter, that the Feast of *Easter* was very often observed erroneously, according to the *Julian* Calendar; but, according to the *Gregorian* Calendar, *Easter* Day will always be observed, as it was established by the General Council of *Nice*, *Anno* 325, viz. The first *Sunday* after the first Full Moon, that happens upon or next after the Day of the Vernal Equinox; and if the Full Moon happen on a *Sunday*, *Easter* Day will always be the *Sunday* after. So that *Easter* Full Moon will always happen between the 21st Day of *March*, and the 18th of *April*, both Days inclusive. The Time of the Vernal Equinox being fixed by the *Gregorian* Calendar to the 21st Day of *March*, according to the aforesaid Establishment, *Easter* Day may always be found by the following

R U L E.

Seek the Epact for the Year proposed, and if it is less than 24, subtract it from 44, but if it exceeds 24, subtract it from 74; and if the Epact is 24, it must be taken from 73, and also if the Epact is 25, and the Golden between 12 and 19, both Numbers inclusive the Epact, must be taken from 73, the Remainder will be *Easter* Limit, or the Day of the Paschal Full Moon. If the Limit is less than 32, the Full Moon is in *March*, but if it exceeds 31, the Day of the Full Moon is in *April*. The *Sunday* after is *Easter* Day.

EXAMPLE

EXAMPLE I.

I would know *Easter* Day for the Year 1753?

$$\begin{array}{r}
 1753 \\
 \text{I} \\
 \hline
 19)1754(92 \\
 \hline
 44 \\
 \hline
 \text{The Golden Number } 6 \\
 \text{Multiplied by } 11 \\
 \hline
 30)66(2 \\
 \hline
 \text{The Julian Epact } 6 \\
 \text{Add } 30 \\
 \hline
 36 \\
 \text{Subtract } 11 \\
 \hline
 \text{The Gregorian Epact } 25 \\
 \hline
 \text{From } 74 \\
 \text{Sub. Gregorian Epact } 25 \\
 \hline
 \text{Easter Limit } 49 \\
 \text{Sub. March } 31 \\
 \hline
 \text{Easter Limit April } 18 \\
 \hline
 \end{array}$$

The Dominical Letter by Chap. VII. will be found G; then add 4 to the Number of the Dominical Letter (as in Chap. VIII.) and subtract this Sum from *Easter* Limit, and the Residue

fidue from the nearest greater Sum of Sevens,
this last Remainder added to the Limit, gives
Easter Day.

The W O R K.

<i>Easter Limit</i>	49	
Sum of the Letter and 4	11	
	—	
Remainder Sub.	38	
Nearest Sum of Sevens	42	
	—	
4 Add to Limit	49	
	4	
	—	
Sum	53	
<i>March</i>	31	
	—	
<i>Easter Day April</i>	22	

Easter Day according to the *Julian* Calendar,
should be the 11th of *April*.

E X A M P L E II.

What Day of the Month will *Easter Day* hap-
pen on for the Year 1754?

Find by Chap. 3, the Golden Number 7
Find by Chap. 5, the Epact ——— 6
And by Chap. 7, the Dominical Letter F
then

From

[29]

From	44	
Sub. Epact.	6	
	—	
Remains	38	
Sum, Letter and 4	10	
	—	
Rem. Sub.	28	
Nearest Sum of Sevens	35	
	—	
7	Add to Limit	38
		7
		—
	Sum	45
	March	31
		—

Easter Day April 14

Easter Day found by the Julian Calendar will be the 3d of April.

EXAMPLE III.

What Day of the Month will *Easter Day* fall on in the Year 3203?

The Year	3203	
Add	1	
	—	
	19)3204(168	
	—	
	130	
	—	
	164	
	—	
The Golden Number	12	
Multiplied by	11	
	—	
	3 0)13 2(4	The Quotient.
	—	
The Julian Epact	12	

I find by the Table Chap. 8. Page 12, that 17 is the Number to be subtracted from the *Julian* Epact, then

The Epact <i>Julian</i>	12
Add	30
	—
	42
Sub. the Number in the Table	17
	—
The Epact <i>Gregorian</i>	25

Find how many Days the *Gregorian* Stile has gained of the *Julian*, by Chap. 5, Rule 1.

	4)32	The entire Hundred Years.
	—	
The Quotient	8	
Add	2	
	—	
Subtract	10	
	—	
The <i>Gregorian</i> Stile	} 22	
will have gained		
of the <i>Julian</i>		

Now to find the Dominical Letter, proceed

	4)3203
	800
	4
	—
	4007
Number of Days found	22
	—
	7)3985(7
	—

569—2
The Number of the Dominical Letter 5 answers to E.
According

According to the Rule the Epact must be taken from 73 (because the Epact is 25 and the Golden Number 12) in order to find *Easter* Limit, then

To find Easter Day.

From	73	
.Sub. Epact.	25	
	—	
<i>Easter</i> Limit	48	
Sum of the Letter and 4	= 9	
	—	
Rem. Sub.	39	
Nearest Sum of Sevens	42	
	—	
3	Add to Limit	48
		3
		—
	Sum	51
	<i>March</i>	31
		—
	<i>April</i> the	20

So that *Easter* Day according to the *Gregorian* Calendar will happen on the 20th of *April*. I observe in this Question that the Vernal Equinox in that Year will have gone back 11 Days more, so that the Vernal Equinox that Year will happen the 27th of *February*, (if the *Julian* Stile continue in Use so long) and *Easter* Day in those Times will not happen once in three Years according to its first Establishment by the General Council of *Nice*.

But it may be asked by some People, why *Easter* should be a moveable Feast any more than the Deaths of the Apostles, or other Feast and Fast Days observed by the Church of *England*?

To

To which I answer, 1st. That there might be some Analogy, or Correspondency between the Jewish * and Christian *Pascha*, or *Easter*, but so, that the Jewish Solemnity might at no Time concur with the Christian Memorial of the Resurrection of *Christ*. 2dly. That at no Time an Eclipse of the Sun should be seen at the Feast of *Easter*, as that, which was miraculous at the Death of *Christ*, and, contrary to the Course of Nature, happening at the Full Moon, lest it might give Occasion to the *Jews* and *Infidels* to calumniate the *Christians*.

C H A P. X.

Of the Moon's Age.

THE Age of the Moon found by the Epacts is near the Truth, according to the Moon's middle Motion, and may be found by the following

R U L E.

Add to the Epact for the given Year the Day of the Month, and the Number of the Months as here is set down, and if the Sum is under 30, that is, the Moon's Age, but if it exceeds 30, cast away 30, and the Remainder is the Moon's Age. The Months must be numbered thus,

0	2	1	2	3	4
January,	February,	March,	April,	May,	June,
5	6	8	8	10	
July,	August,	September,	October,	November,	
10					
December.					

* *Exodus* the xii and xiii Chapters, *Luke* the xxii, *Matthew* the xxvi, *Mark* the xiv.

Note,

Note, You must make use of the Epact for the Stile that you would find the Moon's Age for.

EXAMPLE I.

How old will the Moon be the 20th of *May*, 1753 ? according to the *Gregorian* Stile.

Find the Epact by Chap. V. which is 25.

The Epact	25
The Number of the Month	3
The Day of the Month	20
	—
	48
	30
	—
The Moon's Age	18 Days

The Day of the New Moon is gained by adding the Number of the Month, and the Epact together, and subtract the Sum from 30, but if the Sum exceeds 30, subtract it from 59, and the Remainder is the Day of the New Moon, according to her middle Motion, and the Day of the Full Moon is gained by subtracting the above-mentioned Sum from 15 ; but when Subtraction cannot be made, borrow 30 Days, and the Remainder will give you the Day of the Full Moon, according to her mean Motion.

EXAMPLE II.

I would know the Day of, the Full Moon for the Month of *December*, 1753.

The Epact as before 25
The Num. of the Month 10

Take 35

30

15

From 45

Answ. Full Moon the 10 Day of *December*.

EXAMPLE III.

I would know the Day of the New Moon for the Month of *August*, 1753?

The Epact 25
Number of the Month 6

31

59

New Moon the 28 Day of *August*.

EXAMPLE

EXAMPLE IV.

I would know the Moon's Age for the 5th Day of *September*, 1754.

Find the Epact by Chap. V. which is 6.

The Epact	6
The Number of the Month	8
The Day of the Month	5

The Moon's Age 19 Days

How old will the Moon be *July* 6, *Anno* 3504 ?

3504
1
19)3505(184
160
85

The Golden No.	9
Multiplied by	11

310919(3

The *Julian* Epact 9

I find by the Table, Chap. V. Page 12. that 19 is the Number to be subtracted from the *Julian* Epact, in order to find the *Gregorian* Epact.

[36]

The *Julian* Epact 9

Add 30

The Sum 39

The Number sub. 19

The *Gregorian* Epact 20

The Epact 20

The Number of the Month 5

The Day of the Month 6

From 31

Sub. 30

The Age of the Moon 1 Day.

In all these Examples the Moon's Age was found for the *Gregorian* Stile; but if you would find it for the *Julian*, you must make use of the *Julian* Epact.

C H A P. XI.

Of the Moon's Southing.

THE Moon's Southing, is the Time of her coming to, or upon the Meridian; which, from the New Moon to her Full, is after Noon, but from the Full to the Change, is before Noon, in finding which use this

RULE.

R U L E.

Multiply the Moon's Age by 4, and divide the Product by 5, the Quotient is Hours, and the Remainder is so many 12 Minutes of an Hour.

E X A M P L E I.

I would find the Time of the Moon's coming to the South the 17th of *May*, 1753.

25 The Epact found by Chap. V.

The Epact	25
The Number of the Month	3
The Day of the Month	17

—
45
30
—

The Moon's Age	15
Multiplied by	4

5)60(12 Hours. The
— Time of the
Moon's coming
to the South.

The Moon will come to the South, or be upon the Meridian, at Twelve o'Clock at Night.

EXAMPLE II.

I would know the Time of the Moon's coming to the South, *Anno* 1805, *March* the 25th.

First find the Epact.

The Year	1805
Add	1
	19)1806(94

96

The Golden Number	20
Multiplied by	11
	310)2210(7

The <i>Julian</i> Epact	10

I find by the Table Chap. V. Page 12, that 11 is the Number, to be subtracted from the *Julian* Epact, in order to find the *Gregorian* Epact

The <i>Julian</i> Epact	10
Add	30

The Sum	40
Subtract	11

The <i>Gregorian</i> Epact	29

The Epact <i>Gregorian</i>	29
The Number of the Month	1
The Day of the Month	25

The

The Sum 55
Subtract 30

The Moon's Age 25
Subtract 15

Days after the Full 10
Multiplied by 4

5)40(

The Time of the Moon's } 8 Hours.
southing

Because the Moon is past the Full, therefore the Moon comes to the South the 26th Day, at 8 o'Clock in the Morning, or the 25th Day, at 12 Min. after 7 in the Morning.

EXAMPLE III.

To find the Time of the Moon's coming to the South for the Year 3427, *June* the 15th.

The Year 3427
Add 1

19)3428(180

152

The Golden Number 8
Multiplied by 11

3|0)8|8|2

The *Julian* Epact 28

I find

I find in the Table, Chap. 5. Page 12, that 18 is the Number to be Subtracted from the *Julian* Epact, in order to find the *Gregorian* Epact, then

The <i>Julian</i> Epact	28
Subtract the No. found in the Table	18
The <i>Gregorian</i> Epact	10
Add the Number of the Month	4
Add the Day of the Month	15
The Moon's Age	29 Days
Subtract	15
Days after the Full	14
Days after the Full	14
Multiplied by	4
	5)56
	11 : 12

The Time of the Moon's coming to the South is 12 Min. after 11 o'Clock in the Morning.

Of the Time of High Water.

WHEN the Sun and Moon are in Conjunction, or Opposition, that is, at New or Full Moon, the Attraction of both these Bodies acting upon the Earth in the same Direction, or in the same Right Line, their Force is united to elevate the Waters, whereby are produced Spring Tides, and the highest Spring Tides are before the Vernal and after the autumnal Equinox.

When

When the Moon is in her Quadratures, her Attraction acts in one Direction, the Sun's in a quite contrary ; by which Means they correct or counteract one another, the Moon raising the Waters where the Sun depresses them, and *vice versa*, which produces Neap-Tides, and the weakest Neap-Tides happen, when the Sun is near the Tropics.

The Time of High Water may be found near enough for common Use by the following

R U L E.

To the Moon's Southing, add the Point of the Compass making Full Sea (on the Full and Change Day) for the Place proposed, that Sum is the Time of High Water or Full Sea.

The Hours and Minutes answering to the Point of the Compass making Full Sea, may be had by Inspection from the following Table, for the following Places.

G

The

The Names of P O R T S.

Subtract H. M.		Add H. M.
12 24	Portsmouth, Southampton, Queenborough, Isle of Wight.	0 0
11 38	Rochester, Aberdeen, Winchelsea, and Flushing.	0 46
10 51	Downs, Gravesend, Scilly, Thanet, and Guernsey.	1 33
10 5	London, Dundee, St. Andrews, Holy-Isle, and Bell-Isle.	2 19
9 19	Tinmouth, Hartlepool, and West Coast of Ireland.	3 6
8 32	Bridlington-bay, Berwick, Flamborough, Rochel.	3 52
7 45	Scarborough, Mounts-bay, Kinsale, and Humber.	4 39
6 59	Newcastle, Falmouth, Dartmouth, Lizard.	5 25
6 12	Plymouth, Hull, Lynn, Fosdike, and Cross-keys.	6 12
5 26	Weymouth, Lime, Bristol, Boston, St. Nicholas.	6 53
4 40	Milford-haven, Bridgewater, Land's-end, Portland.	7 45
3 53	Hague, Dublin, Peterport, Harflew, St. Magnus.	8 31
3 7	Pool, St. Helens, Cathness, Orkney, Isle of Man.	9 18
2 20	The Needles, Layflow, the North and South Forelands.	10 4
1 33	Yarmouth, Dover, Harwich, Cowes, and Calais-Road.	10 51
0 47	Rye, Sole-bay, Goore, and Margaret-Road.	11 37

The Use of the Table is very easy to understand; for if on any Day proposed you subtract the Hours and Minutes that stand in the Left Hand Column against any Port, from the Time of the Moon's Southing, or add those in the Right Hand Column, the Difference and Sum of those Numbers will be the Times of High Water at the Place required.

EXAMPLE I.

I would know the Time of High Water at *London* the 16th of *September*, 1753.

I find by Chap. V. the Epact for that Year, which is 25.

The Epact	25
The Number of the Month	8
The Day of the Month	16

	49
Subtract	30

The Moon's Age 19 Days

	4
	—
5)76(	
	—

151:2

I subtract 10 H. 5 Min. the Left Hand tabular Number against *London*, from 15 H. 12 M. and the Difference is 5 H. 7 Min. Afternoon, the Time of High Water at *London* on that Day, then I add 2 H. 19 M. the Right Hand tabular Number, to the said Time of her Southing, and the Sum is 17 H. 31 M. Afternoon, that is the 17th Day, at 31 M. after 5 in the Morning, for the next Time of High-Water at *London*.

[44]

EXAMPLE II.

I would know the Time of High-Water for
Gravesend the 29th of *May*, 1946?

1946
Add 1

19)1947(102

47

The Golden Number 9
Multiplied by 11

310)919(

The *Julian* Epact 9
Add 30

Number in the Table sub. 39
12

The *Gregorian* Epact 27
The Number of the Month 3
The Day of the Month 29

Sub. 59
30

Sub. 29
15

Days after the Full 14
Multiplied by 4

5)56

Moon's South 11 : 12

I find in the Tide Table that 10 h. 51 min. is to be substracted for *Gravesend*, and 1 h. 33 min. added.

The Moon's Southing 11 : 12
Sub. 10 : 51

High Water 0 : 21

High Water 12 : 45

So that the Times of High Water are 29 D. 12 H. 21 Min. or 21 Min. after 12 in the Morning the 30th Day, and the next Tide 45 Min. after 12 at Noon the 30th Day.

The Time of the Tides found as above, will be near enough for common Use, or you may make about 20 Min. Allowance, as is directed in the 1st Part of this Chapter.

Note in the three last Chapters, I have made use of the *Gregorian* Epacts, but, if you would find the Moon's Age, Moon's Southing, or the Time of High Water for the *Julian* Stile, you must make Use of the *Julian* Epact.

C H A P. XIII.

Of the Calends, Nones, and Ides.

THE Calends are the first Day of each Month. The Nones are the 7th Day of the four Months, *March*, *May*, *July*, and *October*, and the 5th Day of the other Months: And the Ides come 8 Days after the Nones, that is, on the 15th Day of *March*, *May*, *July*, and *October*, and the 13th of the other Months.

The

The other Days are counted backwards, still diminishing the Number; for the Days between the Calends, and the Nones of any Month, are denominated from the Nones; and so of the rest as you see in the Calendar.

C H A P. XIV.

Of the Roman Indiction.

THE Roman Indiction has no Connexion with the Celestial Motions, but because the Famous Period of 7980, called the *Julian* Period, is produced from it, I shall not pass it over in Silence.

The Roman Indiction is a Term of 15 Years, at the End of which they began their Computation with a continual Circulation; this Period was called Indiction as some will have it, because it serv'd to point out the Year of Payment of the Tax or Tribute to the Republick. To find it use this

R U L E.

Add three to the Year of our Lord, and divide the Sum by 15, and the Remainder is the Year of Indiction.

E X A M P L E I.

What was the Roman Indiction for the Year 1730.

1730

[47]

Add ¹⁷³⁰
3

15)1733(115

23

83

The Roman Indiction 8

EXAMPLE II.

What was the Roman Indiction for the Year 1740?

Add ¹⁷⁴⁰
3

15)1743(116

24

93

The Roman Indiction 3

CHAP. XV.

Of the Julian Period.

THE *Julian* Period is a Cycle of 7980 Years, produced by the Multiplication of three Cycles, *viz.* That of the Sun 28, of the Moon 19, and that of the Roman Indiction 15 Years, this was the Invention of *Julius Scaliger*, who fixed the Beginning of it 764 Years before the Creation;

Creation; so that at the Birth of *Christ* it was 4713. Therefore, if to the current Year of *Christ* you add 4713, the Sum will be the Year of the *Julian* Period; and from the Year of the *Julian* Period subtract 4713, there will remain the Year of the Christian *Era*.

EXAMPLE I.

I would know the *Julian* Period for the Year 1753.

$$\begin{array}{r} 1753 \\ \text{Add: } 4713 \\ \hline \text{The } \textit{Julian} \text{ Period } 6466 \end{array}$$

EXAMPLE II.

What was the *Julian* Period for the Year 1604?

$$\begin{array}{r} 1604 \\ \text{Add } 4713 \\ \hline \text{The } \textit{Julian} \text{ Period } 6317 \end{array}$$

EXAMPLE III.

I would know the Year of *Christ* when the *Julian* Period will be 7604.

$$\begin{array}{r} 7604 \\ \text{Sub. } 4713 \\ \hline \text{The Year of } \textit{Christ} 2891 \end{array}$$

THE *Julian* Period is a Cycle of 7980 Years, composed by the Multiplication of three Numbers, to wit, of the Moon, of the Sun, and of the Indiction, who fixed the Beginning of it 304 Years before the Creation;

F I N I S.

20 JY 63

